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### **Association between Emotion Regulation and Math Anxiety in Elementary Students**

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**Abstract:** Current research investigates the association between emotion regulation and mathematical anxiety. However, many studies examine this relationship in adolescents and adults. The objective of this study was to investigate the association between emotion regulation and mathematical anxiety in fifth-grade elementary students. This quantitative and exploratory research was conducted with 54 children aged 10 to 13 years. Descriptive analyses, correlations, and simple regression analyses were conducted using the scores from the Emotion Regulation and Mathematical Anxiety Questionnaire instruments. Negative correlations were found between the use of fear and anger regulation strategies and both general mathematical anxiety and anxiety during activities performed at home. Associations were also observed between the harmful character of fear and emotion recognition and anxiety during written calculations. These findings suggest that specific components of emotion regulation are associated with dimensions of mathematical anxiety in childhood.

**Keywords:** math anxiety, emotion regulation, elementary school students

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## **Associação entre Regulação Emocional e Ansiedade Matemática em Estudantes do Ensino Fundamental**

**Resumo:** Atualmente pesquisas investigam a associação da regulação emocional no controle da ansiedade matemática, contudo, muitas averigam essa associação em adolescentes e adultos. Assim, o objetivo deste trabalho foi investigar a associação entre regulação emocional e ansiedade matemática em alunos do quinto ano do fundamental I. Foi uma pesquisa quantitativa e exploratória, realizada com 54 crianças, idades entre 10 e 13 anos. Realizaram-se análises descritivas, correlações e regressões simples com os escores dos instrumentos de Regulação Emocional e do Questionário de Ansiedade Matemática. Foram encontradas correlações negativas entre o uso de estratégias de regulação do medo e da raiva e a ansiedade matemática geral e em atividades realizadas em casa. E também foram observadas associações entre o caráter prejudicial do medo e o reconhecimento das emoções com a ansiedade em cálculos escritos. Os achados sugerem que componentes específicos da regulação emocional estão associados a dimensões da ansiedade matemática na infância.

**Palavras-chave:** ansiedade matemática, regulação emocional, estudantes do ensino fundamental

## **Asociación entre Regulación Emocional y Ansiedad Matemática en Estudiantes de Educación Primaria**

**Resumen:** Las investigaciones actuales analizan la relación entre la regulación emocional y la ansiedad matemática, pero muchas se centran en adolescentes y adultos. El objetivo de este estudio fue investigar dicha asociación en estudiantes de quinto grado de educación primaria. La investigación fue cuantitativa y exploratoria, realizada con 54 niños de entre 10 y 13 años. Se realizaron análisis descriptivos, correlaciones y regresiones simples con las puntuaciones

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

de los instrumentos de Regulación Emocional y del Cuestionario de Ansiedad Matemática. Se encontraron correlaciones negativas entre el uso de estrategias de regulación del miedo y la ira y la ansiedad matemática general y la ansiedad durante actividades realizadas en casa. También se observaron asociaciones entre el carácter perjudicial del miedo y el reconocimiento de las emociones y la ansiedad durante cálculos escritos. Los hallazgos sugieren que componentes específicos de la regulación emocional están asociados con dimensiones de la ansiedad matemática en la infancia.

**Palabras clave:** ansiedad matemática, regulación emocional, alumnos de primaria

General Anxiety (GA) is a natural reaction generated by a stimulus that results in a state of alertness, tension, and unpleasant symptoms that can be physical, physiological, and emotional, which occur when the individual is in contact with dangers or emergencies. GA manifests in two distinct forms: state anxiety and trait anxiety. The former represents a transient emotional response to particular circumstances, whereas the latter reflects an enduring personality characteristic of the individual (Fenzke et al., 2023; Gama et al., 2008; Santos & Galdeano, 2009).

Mathematical Anxiety (MA), although it may present physiological, physical, and emotional reactions, only manifests itself when the individual is in contact with tasks that involve mathematics, such as solving accounts or arithmetic assessments (Barroso et al., 2021; Cheng et al., 2022; Ferreira et al., 2025; Lunardon et al., 2025). Math Anxiety can affect both cognitive and emotional aspects and can be categorized into State MA, that is temporary and situational, and Trait MA, representing an enduring individual disposition (Campos, 2022, Lima, 2022; Pelegrina et al., 2024). Over the years, it has become a factor studied to understand how it is associated with students' mathematical academic performance and with people's professional and daily choices (Curilla & Carmo, 2023). It is a factor that

affects men and women, and it has genetic, psychological, physiological, social, and emotional factors (Moura-Silva et al., 2020).

Emotion Regulation (ER) can be defined as the ability to identify, maintain, or modify the innate and universal emotions present in human beings (Hoemann et al., 2019) and two ER strategies are widely known and studied, namely Cognitive Reappraisal (CR) and Expressive Suppression (ES). CR is a strategy that seeks to cognitively modify a potentially emotion-generating situation in a way that changes the emotional impact, thus modifying the emotional response to that situation. At the same time, Expressive Suppression is a response modulation that consists of attempting to hide feelings, involving inhibition of emotion-expressive behavior (Gross & John, 2003).

When it comes to General Anxiety and ER, research suggests that individuals with general anxiety disorders tend to use maladaptive strategies, such as Expressive Suppression, rather than adaptive ones, such as Cognitive Reappraisal, to mitigate the effects of Anxiety (Liu et al., 2018; O'Toole et al., 2014), while in Mathematical Anxiety research associates that using the Cognitive Reappraisal strategy is more effective in reducing the effects of mathematical Anxiety in individuals, mainly in reducing response time in mathematical activities and improving performance in arithmetic tasks (Pizzie et al., 2020; Suárez-Pellicioni et al., 2015). Thus, research such as those by Artemenko et al. (2015), Megreya and Al-Emadi (2024) and Pizzie and Kraemer (2023) associated poorer academic performance with higher levels of math anxiety, which in turn were associated with associated with poorer development of ER strategies. In this way, it was possible to observe that children with high math anxiety showed satisfactory math performance when they had high ER (Artemenko et al., 2015).

Empirical investigations into the association between emotional regulation (ER) and mathematics anxiety (MA) typically focus on elucidating one or more of the following

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

aspects: first, attentional issues in arithmetic activities in individuals with high MA, based on the level of development of ER; second, the association between ER and arithmetic performance, with ER as a mediator; and third, to verify which ER strategies can best mitigate the effects of MA in individuals when in contact with arithmetic tasks.

In this way, some studies such as Cohen and Rubinsten (2022) and Suárez-Pellicioni et al. (2015) were carried out to understand the attentional effects of math anxiety on arithmetic tasks and how ER can help decrease response time and increase attentional focus on the task itself, rather than the emotions that the task evokes, while works such as Cohen et al. (2021), Pizzie et al. (2020) and Zhu et al. (2022) sought to understand how ER can attenuate the physiological and emotional effects of individuals when in contact with tasks involving mathematics, stating that the ER strategy of cognitive Reappraisal can be very effective in reducing these physiological effects and increasing the accuracy of arithmetic tasks, and finally, other studies sought to investigate whether starting ER training from primary school onwards can help reduce the effect of children's mathematical Anxiety (Petronzi et al., 2024) and whether the concentrated breathing strategy, before taking mathematics tests can be a good strategy to reduce the physiological effects of mathematical Anxiety and reduce the emotional effects of arithmetic tasks (Brunyé et al., 2013).

In summary, recent literature suggests that the relationship between Emotion Regulation (ER) and Mathematical Anxiety (MA) is more complex than global models may indicate. Although studies with adults have associated strategies such as Cognitive Reappraisal (CR) with reduced effects of anxiety during mathematical tasks (Cohen & Rubinsten, 2022; Pizzie et al., 2020), recent evidence with children suggests that the spontaneous use of these strategies under high pressure may, under certain conditions, increase demands on working memory and impair mathematical performance (Peng & Ma, 2025). These findings indicate that the effects of ER may depend both on the context and on

the specific characteristics of the mathematical situation. In addition, recent studies suggest that different emotional components may show distinct relationships with MA (Pizzie & Kramer, 2023; Petronzi et al., 2024). Therefore, investigating specific components of the regulation of negative emotions may contribute to a more differentiated understanding of the relationship between ER and MA.

Most research, however, investigated the association between Mathematical Anxiety and ER in adolescents and/or adults. Those carried out with children focused only on ER training without statistically examining the association between the two constructs, as seen in the research by Petronzi et al. (2024), which sought to train an approach using a storybook to normalize a conversation about mathematics and the feelings that surround it. Thinking about this problem, the objective of this study was to investigate the association between emotion regulation and mathematical anxiety in fifth-grade elementary students, and the hypothesis was that there is a negative correlation between the ER of Fear, Anger, and Sadness and Mathematical Anxiety. It is characterized as a quantitative and exploratory study, as it is an investigation with little data and statistical models that seek to analyze this association in children.

## **Method**

### **Participants**

The study was conducted with a non-probabilistic convenience sample of 54 students, of whom 28 (51.9%) were male and 26 (48.1%) were female, aged between 10 and 13 years ( $MD = 10.59$ ,  $SD = 0.714$ ). The inclusion and exclusion criteria were as follows: participants had to be typically developing students without any documented clinical diagnoses, regularly enrolled in the fifth grade of elementary school, and within the specified age range.

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

## Instruments

We used the Emotion Regulation Assessment Scale for Elementary School Students (ERE-EF) and the Mathematical Anxiety Questionnaire (MAQ) to determine whether there is an association between ER strategies and the participants' mathematical anxiety levels.

*The Emotion Regulation Assessment Scale for Elementary School Students (ERE-EF)*. is an instrument composed of 113 Likert-type items, developed by Cruvinel and Boruchovitch that seeks to identify how students deal with their own emotions, namely, Sadness (33 items), Anger (30 items), Fear (22 items) and Joy (17 items), in addition to mapping four components of ER, namely: the use of strategies (UE) to maintain or modify the emotions felt, the harmful character (HC) of these emotions, the Causing Reasons (CR) and their Perception (PE) of the emotions felt by them, by their parents, teachers and classmates, with Joy being the only one that does not map the harmful character in its subscale.

*The Mathematical Anxiety Questionnaire (MAQ)*. is a questionnaire developed by Wood et al. (2012) and adapted by Haase et al. (2012), based on the *Math Anxiety Questionnaire* (MAQ) developed by Wigfield and Meece (1998), and the MAQ consists of 24 items, answered on a five-point scale. The MAQ has six different categories related to math anxiety for each question asked: general math (AGM), easy calculations (AEC), difficult calculations (ADC), written calculations (AWC), mental calculations (AMC), and mathematics “homework“ (in this research, the term will be "mathematics activities conducted at home") will also be used (AMHW), divided into four types of questions that evaluate two aspects of Mathematical Assessment, separated into “MAQ A” self-perception concerning academic performance and “MAQ B” attitudes in mathematics; and Mathematical Anxiety, separated into “MAQ C” unhappiness related to mathematical problems; and “MAQ D” anxiety related to problems involving mathematics.

## Procedures

**Data Collection.** Data were collected across two individual sessions, each lasting between 30 and 60 minutes, conducted in two public elementary schools.

**Data analysis.** The internal consistency analyses were conducted using JASP software, version 0.19.3. The internal consistency of the instruments, factors, and components was assessed using Cronbach's alpha ( $\alpha$ ) and McDonald's omega ( $\omega$ ) coefficients (Dunn et al., 2014).

For the interpretation of the coefficients, 0.70 was adopted as the reference value for adequate internal consistency (Prinsen et al., 2018). Values between 0.60 and 0.69 were considered acceptable for exploratory purposes, whereas values below 0.60 were interpreted as indicators of low internal consistency (Balbinotti & Barbosa, 2008; Souza et al., 2017). These values were used as reference points, while also considering item-rest correlations, reliability estimates, theoretical aspects, and sample size.

For the other statistical analyses, we utilized The *Statistical Package for the Social Sciences* (SPSS), version 21. We assessed the sample distribution using the Shapiro-Wilk test ( $p < 0.05$ ). Following Bias-Corrected and Accelerated (*BCa*) data adjustment with a 95% confidence level via Bootstrap, we adopted parametric tests for the subsequent analyses.

To characterize the sample, we performed a descriptive analysis. For the gender variable, we investigated frequency and percentage. We calculated the age variable's mean, standard deviation, and minimum and maximum values. Additionally, we conducted a descriptive analysis of each instrument's results, measuring the frequency of scores for each. We employed the Pearson Coefficient Test for correlation analysis, and for each identified correlation, we performed a Simple Linear Regression test.

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

## Ethics Committee Approval Statement

Data collection followed all research ethics guidelines, starting after approval from the Research Ethics Committee of the Instituto de Psicologia da UFBA (CEP-IPS) of the Universidade Federal da Bahia (CAAE nº 68143423.6.0000.5686).

## Results

We ran the analyses with all the participants' data, and they were split into groups by categories and aspects of each instrument.

## Internal Consistency of the Instruments

### *Internal Consistency of the MAQ*

The analysis of the internal consistency of the MAQ indicated high internal consistency for the total scale, with Cronbach's alpha ( $\alpha = 0.899$ ) and McDonald's omega ( $\omega = 0.901$ ) coefficients. The four factors showed satisfactory coefficients, with  $\alpha$  values ranging from 0.789 to 0.807 and  $\omega$  values ranging from 0.781 to 0.815.

**Table 1**

### *Internal Consistency Estimates for the MAQ*

|            |           | Scale/Factor | No. of Items | Cronbach's alpha ( $\alpha$ ) | McDonald's $\omega$ |
|------------|-----------|--------------|--------------|-------------------------------|---------------------|
|            |           | MAQ Total    | 24           | 0.899                         | 0.901               |
| Components | Factors   | MAQ_A        | 6            | 0.789                         | 0.781               |
|            |           | MAQ_B        | 6            | 0.807                         | 0.815               |
|            |           | MAQ_C        | 6            | 0.802                         | 0.805               |
|            |           | MAQ_D        | 6            | 0.798                         | 0.804               |
|            | Subscales | AGM          | 4            | 0.673                         | 0.689               |
|            |           | AEC          | 4            | 0.639                         | —*                  |
|            |           | ADC          | 4            | 0.657                         | 0.686               |
|            |           | AWC          | 4            | 0.660                         | 0.668               |
|            |           | AMC          | 4            | 0.818                         | 0.833               |
|            |           | AMHW         | 4            | 0.736                         | 0.739               |

\*Note. Created by the authors. McDonald's  $\omega$  could not be estimated for this component due to a software error. MAQ\_A = Component A (Good/Bad), MAQ\_B = Component B (Like/Dislike), MAQ\_C = Component C (Happy/Unhappy), MAQ\_D = Component D (Worried/Calm), AGM = General Mathematics Anxiety, AEC = Anxiety in Easy Calculations, ADC = Anxiety in Difficult Calculations, AWC = Anxiety in Written Calculations, AMC = Anxiety in Mental Calculations, and AMHW = Anxiety in Mathematics Activities Carried Out at Home.

The analysis of the subscales showed greater variability in the internal consistency indicators. Mental Calculations showed the highest coefficients ( $\alpha = 0.818$ ;  $\omega = 0.833$ ), followed by Mathematics Activities Carried Out at Home ( $\alpha = 0.736$ ;  $\omega = 0.739$ ). The remaining subscales showed coefficients below 0.70, ranging from  $\alpha = 0.639$  to 0.673 and from  $\omega = 0.686$  to 0.689. Overall, the results indicate high internal consistency for the total scale and satisfactory internal consistency for the four MAQ factors, whereas the specific subscales showed greater variability, with some coefficients below 0.70.

### ***Internal Consistency of the ERE-EF***

The analysis of the internal consistency of the ERE-EF indicated good internal consistency for the total scale ( $\alpha = 0.852$ ; 95% CI = 0.798–0.906). Among the factors, Sadness showed low internal consistency ( $\alpha = 0.455$ ;  $\omega = 0.305$ ), as did Fear ( $\alpha = 0.628$ ;  $\omega = 0.501$ ) and Anger ( $\alpha = 0.652$ ;  $\omega = 0.054$ ). Joy showed the highest internal consistency indicators ( $\alpha = 0.827$ ;  $\omega = 0.831$ ). Overall, the results for the factors should be interpreted with caution, particularly because of the low coefficients observed for Sadness, Anger, and Fear.

The analysis of the internal consistency of the ERE-EF components revealed variability across factors (Table 2). The  $\alpha$  coefficients ranged from 0.378 to 0.777, whereas the  $\omega$  coefficients ranged from 0.552 to 0.781. The highest indicators were observed for the Harmful Character of Anger component ( $\alpha = 0.777$ ;  $\omega = 0.781$ ), followed by the Causing Reasons for Fear component ( $\alpha = 0.717$ ;  $\omega = 0.717$ ) and the Causing Reasons for Joy component ( $\alpha = 0.720$ ;  $\omega = 0.727$ ). Overall, the results indicate greater variability in internal consistency across components, particularly for the Joy factor.

**Table 2***Internal Consistency Estimates for the ERE-EF Components*

| Factors | Components            | Cronbach's alpha ( $\alpha$ ) | McDonald's $\omega$ |
|---------|-----------------------|-------------------------------|---------------------|
| Sadness | Use of Strategies     | 0.494                         | —*                  |
|         | Harmful Character     | 0.657                         | 0.672               |
|         | Causing Reasons       | 0.682                         | 0.692               |
|         | Perception of Emotion | 0.531                         | 0.552               |
| Anger   | Use of Strategies     | 0.752                         | 0.761               |
|         | Harmful Character     | 0.777                         | 0.781               |
|         | Causing Reasons       | 0.535                         | —*                  |
|         | Perception of Emotion | 0.674                         | 0.687               |
| Fear    | Use of Strategies     | 0.587                         | 0.614               |
|         | Harmful Character     | 0.719                         | 0.721               |
|         | Causing Reasons       | 0.717                         | 0.717               |
|         | Perception of Emotion | 0.629                         | 0.663               |
| Joy     | Use of Strategies     | 0.378                         | —*                  |
|         | Harmful Character     | 0.720                         | 0.727               |
|         | Perception of Emotion | 0.666                         | —*                  |

*\*Note. Created by the authors. McDonald's  $\omega$  could not be estimated for this component due to a software error.*

Despite the variability in the internal consistency coefficients, all components were retained, as the retention decision was not based exclusively on reliability cutoffs, but also on the characteristics of the components and the other findings from the item analyses. The relatively wide confidence intervals observed for some components warrant caution when interpreting the coefficients.

The four General ERE-EF Components presented satisfactory internal consistency. Use of Strategies showed  $\alpha = 0.817$  (95% CI = 0.749–0.884) and  $\omega = 0.831$  (95% CI = 0.767–0.896), while Harmful Character showed  $\alpha = 0.866$  (95% CI = 0.802–0.931) and  $\omega = 0.866$  (95% CI = 0.814–0.918). Causing Reasons showed  $\alpha = 0.829$  (95% CI = 0.764–0.893) and  $\omega = 0.825$  (95% CI = 0.759–0.892), whereas Emotion Perception showed  $\alpha = 0.813$  (95% CI = 0.745–0.881) and  $\omega = 0.818$  (95% CI = 0.747–0.888). Overall, the four General ERE-EF

Components showed good internal consistency, with similar  $\alpha$  and  $\omega$  estimates and relatively narrow confidence intervals.

### Description of Instruments

Table 3 shows the descriptive data of the participant's MAQ and ERE-EF scores. The frequency analysis of each instrument follows the descriptions.

**Table 3**

*MAQ and ERE-EF score descriptions*

|     |                       | <i>N</i> | Mean  | <i>SD</i> | MIN   | Median | MAX    |
|-----|-----------------------|----------|-------|-----------|-------|--------|--------|
| MAQ | AGM                   | 54       | 10.57 | 3.30      | 4.00  | 10.00  | 19.00  |
|     | AEC                   | 54       | 9.09  | 3.76      | 4.00  | 9.00   | 17.00  |
|     | ADC                   | 54       | 11.70 | 3.61      | 5.00  | 11.00  | 20.00  |
|     | AWC                   | 54       | 10.83 | 3.23      | 4.00  | 11.00  | 20.00  |
|     | AMC                   | 54       | 11.44 | 3.93      | 4.00  | 11.00  | 20.00  |
|     | AMHW                  | 54       | 10.57 | 3.57      | 4.00  | 10.50  | 20.00  |
|     | MAQ_A                 | 54       | 14.25 | 4.82      | 6.00  | 14.00  | 26.00  |
|     | MAQ_B                 | 54       | 13.79 | 5.49      | 6.00  | 13.00  | 27.00  |
|     | MAQ_C                 | 54       | 16.75 | 5.23      | 6.00  | 16.50  | 30.00  |
|     | MAQ_D                 | 54       | 19.40 | 5.30      | 6.00  | 20.50  | 29.00  |
|     | MAQ_TOTAL             | 54       | 64.22 | 16.21     | 25.00 | 66.00  | 111.00 |
| ERE | Total Score           | 54       | 67.37 | 5.77      | 56.00 | 67.50  | 81.00  |
|     | Use of Strategies     | 54       | 21.64 | 3.37      | 15.00 | 21.00  | 30.00  |
|     | Harmful Character     | 54       | 14.59 | 2.85      | 7.00  | 15.00  | 21.00  |
|     | Causing Reasons       | 54       | 20.31 | 3.95      | 13.00 | 20.00  | 29.00  |
|     | Perception of Emotion | 54       | 10.81 | 2.19      | 5.00  | 11.00  | 15.00  |
|     | Total Score           | 54       | 62.61 | 6.98      | 45.00 | 62.50  | 81.00  |
|     | Use of Strategies     | 54       | 26.74 | 4.99      | 16.00 | 26.50  | 39.00  |
|     | Harmful Character     | 54       | 16.72 | 3.77      | 8.00  | 17.00  | 24.00  |
|     | Causing Reasons       | 54       | 7.94  | 2.10      | 4.00  | 8.00   | 12.00  |
|     | Perception of Emotion | 54       | 11.20 | 2.60      | 6.00  | 11.00  | 15.00  |
|     | Total Score           | 54       | 66.00 | 7.11      | 53.00 | 65.50  | 80.00  |
|     | Use of Strategies     | 54       | 20.90 | 3.46      | 12.00 | 21.00  | 28.00  |
|     | Harmful Character     | 54       | 12.70 | 3.00      | 6.00  | 12.50  | 18.00  |
|     | Causing Reasons       | 54       | 22.44 | 4.65      | 14.00 | 22.00  | 34.00  |
|     | Perception of Emotion | 54       | 9.94  | 2.49      | 5.00  | 10.00  | 15.00  |
|     | Total Score           | 54       | 44.40 | 5.28      | 26.00 | 45.50  | 51.00  |
|     | Use of Strategies     | 54       | 5.24  | .930      | 3.00  | 6.00   | 6.00   |
|     | Causing Reasons       | 54       | 26.11 | 3.21      | 17.00 | 27.00  | 30.00  |
|     | Perception of Emotion | 54       | 13.05 | 1.99      | 6.00  | 13.00  | 15.00  |

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

|                  |                          | <i>N</i> | Mean   | <i>SD</i> | MIN    | Median | MAX    |
|------------------|--------------------------|----------|--------|-----------|--------|--------|--------|
| General<br>Score | ERE Total Score          | 54       | 240.38 | 20.05     | 189.00 | 242.50 | 289.00 |
|                  | Use of Strategies        | 54       | 74.53  | 10.04     | 49.00  | 74.00  | 97.00  |
|                  | Harmful Character        | 54       | 44.01  | 8.19      | 21.00  | 44.00  | 61.00  |
|                  | Causing Reasons          | 54       | 76.81  | 9.86      | 59.00  | 76.00  | 99.00  |
|                  | Perception of<br>Emotion | 54       | 45.01  | 6.90      | 29.00  | 45.50  | 58.00  |

*\*Note: Created by the authors.*

In the case of MAQ, when performing the frequency for the six anxiety categories, 50% ( $n=27$ ) of the participants had low Anxiety in general mathematics, 48.1% ( $n=26$ ) had low Anxiety in easy calculations, 81.4% had low ( $n=22$ , 40.7%) or moderate ( $n=22$ , 40.7%) anxiety in difficult calculations, 57.4% ( $n=31$ ) had moderate Anxiety in written calculations, 46.3% ( $n=25$ ) had moderate Anxiety in mental calculations, and 85.2% had low ( $n=23$ , 42.6%) or moderate ( $n=23$ , 42.6%) anxiety in mathematical activities carried out at home. When taking the frequency of the four components investigated in the MAQ, 42.6% ( $n=23$ ) of the participants said they reported being good at mathematics, 44.4% ( $n=24$ ) said they liked mathematics, 42.6% ( $n=23$ ) reported feeling neither happiness nor Sadness when in contact with mathematics and 55.6% ( $n = 30$ ) stated that they felt worried when in contact with mathematical tasks.

When performing the frequencies for the ERE-EF, most of the participants had an average development ( $n=24$ , 44.4%) of sadness regulation, an average development ( $n=22$ , 40.7%) of anger regulation, a moderate levels ( $n=25$ , 46.3%) of the ER of fear and joy and a moderate levels ( $n=27$ , 50%) of general ER.

### Correlations and Regressions

Initially, we analyzed the 11 factors of the MAQ and the four factors and total score of the ERE\_EF. However, we did not find a correlation between these variables. Furthermore, we conducted a correlational analysis between the factors of the MAQ and the four components of each emotion (factor) of the ERE-EF.

For the Emotion Sadness (Table 4), six statistically significant, negative, weak correlations were found: between the Use of Strategies to maintain or modify the emotions of Sadness (Sadness UE), with the Total Score of the MAQ ( $r = -.319, p < 0.05$ ), Sadness UE and General Mathematical Anxiety ( $r = -.373, p < 0.01$ ), Sadness UE and Anxiety in Difficult Calculations ( $r = -.340, p < 0.05$ ), Sadness UE and Anxiety in Mental Calculations ( $r = -.279, p < 0.05$ ), Sadness UE and Anxiety in mathematics activities carried out at home ( $r = -.323, p < 0.05$ ) and between Sadness UE and self-perception regarding mathematical performance ( $r = -.302, p < 0.05$ ).

We observed two significant correlations between the components of emotion Anger (Table 4). The first was a negative and weak correlation ( $r = -.322, p < 0.05$ ) between the Use of Strategies to maintain or modify Anger and Anxiety in General Mathematics. The second was a positive and weak correlation ( $r = .309, p < 0.05$ ) between Causing Reasons for Anger (Anger CR) and Anxiety in Written Calculation.

There were two significant correlations for the components of the Emotion Fear (Table 4). The first one was negative and weak ( $r = -.320, p < 0.05$ ) between the Harmful Character of Fear and Anxiety in Written Calculations. The second one was positive and moderate ( $r = .401, p < 0.01$ ) between the Causing Reasons for Fear and Anxiety in Written Calculations. As for the component of the emotion Joy, no significant correlation was found between the four aspects of emotion and the MAQ factors.

**Table 4**

*Correlations between ERE-Ef components and MAQ factors*

|              | 1      | 2      | 3      | 4      | 5      | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|--------------|--------|--------|--------|--------|--------|---|---|---|---|----|----|----|
| 1. Total MAQ | 1      |        |        |        |        |   |   |   |   |    |    |    |
| 2. AGM       | ,838** | 1      |        |        |        |   |   |   |   |    |    |    |
| 3.ADC        | ,760** | ,637** | 1      |        |        |   |   |   |   |    |    |    |
| 4. AMC       | ,830** | ,565** | ,661** | 1      |        |   |   |   |   |    |    |    |
| 5.AWC        | ,748** | ,621** | ,455** | ,496** | 1      |   |   |   |   |    |    |    |
| 6.AMHW       | ,717** | ,614** | ,421** | ,554** | ,382** | 1 |   |   |   |    |    |    |

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

|               |        |         |        |        |        |        |        |        |       |         |         |   |  |
|---------------|--------|---------|--------|--------|--------|--------|--------|--------|-------|---------|---------|---|--|
| 7. MAQ A      | ,718** | ,642**  | ,591** | ,613** | ,566** | ,478** | 1      |        |       |         |         |   |  |
| 8. Sadness UE | -,319* | -,373** | -,340* | -,279* | -,211  | -,323* | -,302* | 1      |       |         |         |   |  |
| 9. Anger UE   | -,147  | -,322*  | -,076  | -,053  | -,121  | -,140  | -,154  | ,636** | 1     |         |         |   |  |
| 10. Anger CR  | ,182   | ,184    | ,023   | ,065   | ,309*  | ,119   | ,241   | -,112  | -,012 | 1       |         |   |  |
| 11. Fear HC   | -,157  | -,102   | ,028   | -,006  | -,320* | -,068  | -,083  | -,111  | -,197 | -,533** | 1       |   |  |
| 12. Fear CR   | ,237   | ,224    | ,051   | ,162   | ,401** | ,023   | ,124   | ,233   | ,273* | ,336*   | -,397** | 1 |  |

Note. \* $p < 0.05$ , \*\* $p < 0.01$ . UE = Use of Strategies; HC = Harmful Character; CR = Causing Reasons.

Simple linear regressions showed two regression models based on the correlations between the components of the Emotion Sadness and the MAQ factors in Table 4. The first one was for Sadness UE and AGM [ $F(1.52)$ ,  $p < 0.01$ ;  $R^2 = 0.139$ ], showing that the use of strategies to maintain or modify Sadness was significantly associated with General Mathematics Anxiety and accounted for 13.9% of its variance, with the following formula:  $y = 18.458 - 0.364 \times (\text{Sadness UE})$ . The second one was for Sadness UE and AMHW [ $F(1.52)$ ,  $p < 0.05$ ;  $R^2 = 0.104$ ], showing that Sadness UE was significantly associated with anxiety in mathematical activities carried out at home and accounted for 10.4% of its variance, with the following formula:  $y = 17.993 - 0.343 \times (\text{Sadness UE})$ .

For the Emotion Anger, two regression models corresponding to the two significant correlations were found. For the Anger UE component and the AGM factor [ $F(1.52)$ ,  $p < 0.05$ ;  $R^2 = 0.104$ ], linear regression showed that the use of strategies to maintain or modify Anger was significantly associated with General Mathematics Anxiety and accounted for 10.4% of its variance, with the following formula:  $y = 16.267 - 0.213 \times (\text{Anger UE})$ . For the CR Anger Component and AWC [ $F(1.52)$ ,  $p < 0.05$ ;  $R^2 = 0.096$ ], linear regression showed that the Causing Reasons component of Anger was significantly associated with Anxiety in Written Calculations and accounted for 9.6% of its variance, with the formula  $y = 7.061 + 0.475 \times (\text{Anger CR})$ .

Two regression models corresponding to the two significant correlations were found for the Emotion Fear components and the MAQ factors. For the Fear HC component and the

AWC factor [ $F(1.52)$ ,  $p < 0.05$ ;  $R^2 = 0.102$ ], simple linear regression showed that the Harmful Character component of Fear was significantly associated with Anxiety in written calculations and accounted for 10.2% of its variance, with the formula  $y = 15.198 - 0.644 \times (\text{Fear HC})$ . For the Fear CR component and the AWC factor [ $F(1.52)$ ,  $p < 0.01$ ;  $R^2 = 0.161$ ], simple linear regression showed that knowing the reasons causing fear was significantly associated with Anxiety in written calculations and accounted for 16.1% of its variance, with the formula  $y = 4.584 + 0.278 \times (\text{Fear CR})$ .

Finally, correlations between the total scores of the four components of total ERE-EF with the MAQ factors (Table 5) showed two statistically significant associations. The first one was negative and weak ( $r = -.329$ ,  $p < 0.05$ ) between ER strategies and Anxiety in General Mathematics, and the second one was positive and weak ( $r = .300$ ,  $p < 0.05$ ) between Causing Reasons and Anxiety in Written Calculations.

**Table 5**

*Correlations between MAQ Factors and General ERE-EF Components*

|              | 1 | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13    | 14      | 15     |
|--------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|---------|--------|
| 1. Total MAQ | 1 | ,838** | ,653** | ,760** | ,748** | ,830** | ,717** | ,718** | ,850** | ,755** | ,778** | -,200  | -,073 | ,145    | -,003  |
| 2. AGM       |   | 1      | ,418** | ,637** | ,621** | ,565** | ,614** | ,642** | ,698** | ,625** | ,640** | -,329* | -,092 | ,093    | -,116  |
| 3. AEC       |   |        | 1      | ,278*  | ,504** | ,451** | ,289*  | ,385** | ,514** | ,595** | ,526** | ,008   | -,251 | ,192    | ,047   |
| 4. ADC       |   |        |        | 1      | ,455** | ,661** | ,421** | ,591** | ,670** | ,530** | ,570** | -,143  | ,104  | -,002   | -,034  |
| 5. AWC       |   |        |        |        | 1      | ,496** | ,382** | ,566** | ,599** | ,567** | ,593** | -,112  | -,156 | ,300*   | ,008   |
| 6. AMC       |   |        |        |        |        | 1      | ,554** | ,613** | ,769** | ,550** | ,642** | -,157  | ,053  | ,103    | ,078   |
| 7. AMHW      |   |        |        |        |        |        | 1      | ,478** | ,605** | ,571** | ,566** | -,194  | -,006 | -,014   | -,017  |
| 8. MAQ A     |   |        |        |        |        |        |        | 1      | ,709** | ,261   | ,294*  | -,256  | -,040 | ,077    | -,022  |
| 9. MAQ B     |   |        |        |        |        |        |        |        | 1      | ,444** | ,479** | -,075  | ,013  | ,146    | ,005   |
| 10. MAQ C    |   |        |        |        |        |        |        |        |        | 1      | ,625** | -,116  | -,084 | ,097    | ,015   |
| 11. MAQ D    |   |        |        |        |        |        |        |        |        |        | 1      | -,187  | -,119 | ,125    | -,011  |
| 12. Total UE |   |        |        |        |        |        |        |        |        |        |        | 1      | -,005 | ,356**  | ,507** |
| 13. Total HC |   |        |        |        |        |        |        |        |        |        |        |        | 1     | -,536** | -,237  |
| 14. Total CR |   |        |        |        |        |        |        |        |        |        |        |        |       | 1       | ,461** |
| 15. Total PE |   |        |        |        |        |        |        |        |        |        |        |        |       |         | 1      |

Note. \* $p < 0.05$ , \*\* $p < 0.01$ .

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

Simple linear regressions were conducted for the significant correlations between the general components of the ERE-EF and the MAQ factors. Only one statistically significant regression model was identified (Table 5). Simple linear regression showed that Total CR was significantly associated with Anxiety in Written Calculations (AWC) and accounted for 9.0% of its variance [ $F(1.52)$ ,  $p < 0.05$ ;  $R^2 = 0.090$ ], with the relationship represented by the following formula:  $y = 3.290 + 0.098 \times (\text{total CR})$ .

### Discussion

As the objective of this study was to investigate the relationship between Emotion Regulation and Mathematical Anxiety in fifth-grade elementary students, we expected to find significant correlations between the total scores on the Fear, Sadness, and Anger ER indexes, as the literature indicates that negative emotions are associated with math anxiety and poorer mathematical performance (Artemenko et al., 2015; Cohen et al., 2021), suggesting that emotion regulation may be associated with individual differences in mathematical anxiety.

However, no significant associations were found between the total scores of the emotions and MA. Instead, significant associations emerged for specific components of Sadness, Anger, and Fear, suggesting that the relationship between emotion regulation and mathematical anxiety may be more specific to particular emotional processes and mathematical contexts than to global scores. This interpretation is consistent with literature suggesting that, in mathematical situations, anxious individuals may experience a diffuse combination of negative affect, such that analyses based on global scores may overlook specific differences between emotional processes and regulation strategies (Justicia-Galino et al., 2016; Megreya & Al-Emadi, 2024).

Regarding Sadness, only two regression models were significant, involving General Mathematics Anxiety and anxiety during mathematical activities at home. The association

with General Mathematics Anxiety may indicate that this factor represents a more global perception of mathematical anxiety, unlike the other specific MAQ factors, which refer to particular situations (Justicia-Galino et al., 2016; Megreya & Al-Emadi, 2024). One possible explanation is that respondents may have perceived general anxiety as a broader and more stable experience, whereas reactions to the other specific factors, such as easy, difficult, or written calculations, may vary across respondents.

The association with anxiety during mathematics activities at home may reflect the emotional demands involved in these situations, particularly because students may have less support from teachers or peers. In addition, one of the most prominent and consistent symptoms of mathematical anxiety is task avoidance behavior, which may manifest as the avoidance or postponement of mathematics-related activities and homework (Pizzie & Kramer, 2023). However, the cross-sectional design does not allow us to determine the direction of this relationship.

Regarding the components of the emotion Anger, the Use of Strategies to modify Anger was negatively associated with General Mathematics Anxiety, which is consistent with previous literature linking negative emotions to poorer mathematical experiences (Artemenko et al., 2015; Pizzie & Kramer, 2023). In contrast, recognizing the reasons that cause Anger was positively associated with anxiety during written calculations. Although general anxiety and mathematical anxiety are distinct constructs, they may overlap in their emotional manifestations. The DSM-5 (American Psychiatric Association, 2014) indicates that anxiety in children may be accompanied by irritability or anger-related reactions. Thus, when confronted with written calculations, some children may express mathematical anxiety through anger or irritability, potentially contributing to the observed association. To our knowledge, no published studies have directly examined this association. Therefore, this finding should be interpreted cautiously, as it may reflect greater awareness of negative

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

emotional experiences during mathematical tasks, sample-specific variation, or an isolated statistical finding, and should be replicated in future studies.

Regarding Fear, the Harmful Character component was negatively associated with anxiety in written calculations, whereas Causing Reasons for Fear showed a positive association with the same anxiety dimension. These findings suggest that different components of the same emotion may be associated with mathematical anxiety in different directions. This pattern is not necessarily uncommon, considering that previous studies have found that individuals with higher levels of mathematical anxiety show lower levels of emotional clarity and that mathematical anxiety may also be positively associated with maladaptive components of emotion regulation (Justicia-Galino et al., 2016; Megreya & Al-Emadi, 2024). However, these associations should not be interpreted causally, as greater anxiety may also influence how students perceive and report their emotional experiences.

Regarding the Emotion Joy, no correlation was found between its components and mathematical anxiety, which is consistent with literature suggesting that positive emotions such as joy and relief may be more commonly experienced after completing mathematical tasks (Artemenko et al., 2015). However, the absence of significant associations does not indicate that positive emotions are irrelevant to students' experiences with mathematics.

Taken together, these findings suggest that the relationship between emotion regulation and mathematical anxiety is not uniform across emotional domains. Significant associations were concentrated in specific components of Sadness, Anger, and Fear and in particular mathematical contexts, rather than being consistently observed for global emotion regulation scores. This pattern suggests that examining specific emotional processes may provide a more informative understanding of mathematical anxiety than relying solely on overall emotion regulation scores.

Although several associations reached statistical significance, their practical magnitude was predominantly modest. The correlations were generally weak, and the regression models explained between 9.0% and 16.1% of the variance in the respective mathematical anxiety outcomes. Thus, these findings should not be interpreted as indicating that emotion regulation is a comprehensive explanation of mathematical anxiety, but rather as suggesting that specific emotion regulation processes may represent one of several factors associated with students' experiences of mathematics (Cohen & Rubinsten, 2022; Megreya & Al-Emadi, 2024; Moore & Rubinsten, 2025; Peng & Ma, 2025). From a theoretical perspective, the findings suggest that the association between emotion regulation and mathematical anxiety may be more differentiated than initially expected. The fact that significant associations were observed for specific emotional components, but not consistently for global scores, suggests that different aspects of emotional functioning may have distinct relationships with mathematics-related anxiety.

Several limitations should be considered when interpreting these findings. The relatively small convenience sample ( $N = 54$ ) limits the statistical stability and generalizability of the results. In addition, the cross-sectional and correlational design does not allow causal inferences. The large number of correlations and regression analyses also increases the possibility of Type I error; therefore, the statistically significant associations should be interpreted cautiously and considered exploratory and hypothesis-generating rather than confirmatory. Future studies should replicate these findings in larger and more diverse samples, preferably using longitudinal or experimental designs.

Overall, the present findings provide preliminary evidence that specific components of emotion regulation are associated with mathematical anxiety in fifth-grade students. The predominantly weak associations and modest explained variance suggest that these relationships should be understood as part of a broader set of emotional and contextual

Guilherme, T. S.. et al. (2026). Emotion Regulation, Math Anxiety, Students.

factors. These findings contribute to a more differentiated understanding of the relationship between emotion regulation and mathematical anxiety and provide hypotheses for future research with larger samples and more robust longitudinal or experimental designs, particularly to clarify how these associations emerge and operate during childhood.

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Paidéia, 36, e3633

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#### *Research Data Availability*

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

#### *Conflict of interest*

The authors have no conflicts of interest to declare.

#### *Declaration of Use of Artificial Intelligence*

The authors declare that no artificial intelligence tools were used in the writing or editing of this manuscript.

#### *Authors' Contribution:*

All authors made substantial contributions to the conception and design of this study, to data analysis and interpretation, and to the manuscript revision and approval of the final version. All the authors assume public responsibility for the content of the manuscript.

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